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**ASSISTANT COMMISSIONER FOR PATENTS
BOX PATENT APPLICATION
Washington, D.C. 20231**

Sir:

Transmitted herewith for filing under 37 CFR 1.53(b) is the

- ☒ patent application of
☐ continuation patent application of
☐ divisional patent application of
☐ continuation-in-part patent application of

Inventors: ALBERT VODERMAYER, WOLFRAM F.W. AUERSCH

For: AREALLY EXTENDED COMPOSITE MATERIAL WITH FIBERS AND PLASTIC IMPREGNATION

☒ This application claims priority from each of the following Application Nos./filing dates:

European appl. No. 99811116.5, filed December 3, 1999

the disclosure(s) of which is (are) incorporated by reference.

☐ Please amend this application by adding the following before the first sentence: "This application is a ☐ continuation ☐ continuation-in-part of and claims the benefit of U.S. Provisional Application No. 60/_____, filed _____, the disclosure of which is incorporated by reference."

Enclosed are:

- ☒ 7 page(s) of specification
☒ 3 page(s) of claims
☒ 1 page of Abstract
☒ 2 sheet(s) of ☒ formal ☐ informal drawing(s).
☒ An assignment of the invention to Sulzer Innotec AG
☒ A ☒ signed ☐ unsigned Declaration & Power of Attorney
☒ A ☐ signed ☐ unsigned Declaration.
☒ A Power of Attorney by Assignee with Certificate Under 37 CFR Section 3.73(b).
☒ A verified statement to establish small entity status under 37 CFR 1.9 and 37 CFR 1.27 ☐ is enclosed ☐ was filed in the prior application and small entity status is still proper and desired.
☒ A certified copy of a European priority application.
☒ Information Disclosure Statement under 37 CFR 1.97, including EP search report w/Engl. translation, 6 references.
☐ A petition to extend time to respond in the parent application.
☐ Notification of change of ☐ power of attorney ☐ correspondence address filed in prior application.
☒ Preliminary Amendment

	(Col. 1)	(Col. 2)
FOR:	NO. FILED	NO. EXTRA
BASIC FEE		
TOTAL CLAIMS	10 - 20	= *0
INDEP. CLAIMS	1 - 3	= *0
<input type="checkbox"/> MULTIPLE DEPENDENT CLAIM PRESENTED		

* If the difference in Col. 1 is less than 0, enter "0" in Col. 2.

SMALL ENTITY

RATE	FEE
	\$355.00
x \$9.00 =	
x \$40.00 =	
+ \$135.00 =	
TOTAL	

**OTHER THAN
SMALL ENTITY**

RATE	FEE
	\$710.00
x \$18.00 =	\$0.00
x \$80.00 =	\$0.00
+ \$270.00 =	
TOTAL	\$710.00

Please charge Deposit Account No. 20-1430 as follows:

- ☒ Filing fee \$ 710.00
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☐ A check for \$ _____ is enclosed.
2 extra copies of this sheet are enclosed.

Respectfully submitted,
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

ALBERT VODERMAYER, et al.

Application No.: Not yet assigned

Filed: Herewith

For: AREALLY EXTENDED
COMPOSITE MATERIAL WITH
FIBERS AND PLASTIC
IMPREGNATION

PRELIMINARY AMENDMENT

San Francisco, CA 94111
November 28, 20000

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination of the above-referenced application, please enter the following amendments and remarks.

IN THE CLAIMS:

Claim 3, line 1, please delete "or claim 2".

Claim 4, lines 1-2, delete "any one of the claims 1 to 3" and substitute therefor
--claim 1--.

Claim 5, lines 1-2, delete "any one of the claims 1 to 3" and substitute therefor
--claim 1--.

Claim 6, line 2, delete "any one of the claims 1 to 5" and substitute therefor
--claim 1--.

Claim 8, line 2, delete "any one of the claims 1 to 5" and substitute therefor
--claim 1--.

Claim 9, line 2, delete “any one of the claims 1 to 5” and substitute therefor

--claim 1--.

Claim 10, lines 1-2, delete “any one of the claims 1 to 5” and substitute therefor

--claim 1--.


IN THE ABSTRACT:

Following the Abstract of disclosure, delete “(Fig. 3)”.

REMARKS

Amendment is made to delete a minor informality in the Abstract and to eliminate all multiple dependencies from the claims, thereby avoiding the need to pay the multiple dependent surcharge.

Respectfully submitted,


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Areally extended composite material with fibers and plastic impregnation

The invention relates to an areally extended composite material with fibers and plastic impregnation in accordance with the preamble of claim 1, to methods for the manufacture of and to uses of composite materials of this kind.

A method, namely a pressure impregnation, is known from DE-A- 41 21 915 in which an endless reinforcement fiber cord is impregnated with a thermoplastic polymer. In this method the fiber cord is first impregnated with firm thermoplastic particles in a bath which contains a dispersion of the particles. After the impregnation bath the dispersion medium is evaporated out of the impregnated fiber cord in a drying oven. Then the dry fiber cord is passed through an oven in which the particles melt. After a consolidation a small band-like fiber composite material with a firm polymer matrix is present. Small bands of this kind can be arranged to form webs, meshes or grids and formed to areally extended composite materials through a pultrusion in which the polymer matrix is temporarily melted again. Composite materials of this kind can also be brought into the shape of a profiled bar.

Areally extended composite materials are suitable for reinforcing components which are used in building construction, vehicle construction, light construction or the construction of apparatuses and devices. For reinforcement the composite material is applied to the

component with a connecting medium, i.e. with an adhesive.

In reinforcements of components, flexible webs of fiber cords are also used which are adhesively bonded with a plastic mass onto partial surfaces of the component to be reinforced. Reinforcements of this kind are carried out primarily at curved surfaces and at edges. In practice however problems occur in this reinforcing method. The fiber cords of the flexible web can be displaced with respect to one another so that an irregular structure easily arises which is deformed by humps. A web which is deformed in this manner can no longer be applied flatly onto the surface to be reinforced. For a maximum stiffness and strength of the reinforcement, the fibers would have to be completely aligned; a fiber alignment of this kind is however not possible with a deformed web.

The object of the invention is to create an areally extended composite material and methods for manufacturing composite materials of this kind which are suitable for the reinforcement of curved surfaces and edges. This object is satisfied by the composite material which is defined in claim 1.

The areally extended composite material contains fibers which are impregnated with plastic. The composite material comprises at least two arrays of parallel fiber cords which extend in different directions and which form a web, mesh or grid. The fiber cords can be bundle-like or band-like. The fibers of a first array are impregnated with substantially more plastic than the fibers of a second and possibly of a further array. The composite material is stiff in the direction of the fibers of the first

array and is flexible transversely to this direction. Openings advantageously exist between the fiber cords.

Subordinate claims 2 to 5 relate to advantageous embodiments of the composite material in accordance with the invention. Various possibilities for the manufacture of the composite material in accordance with the invention are in each case the subject of the claims 6 to 9. Claim 10 relates to uses of this composite material.

Using the composite material in accordance with the invention, which is semi-flexible, components in the above named fields can be reinforced at edges or cylindrical partial surfaces. In this it can be adhesively bonded or welded on in one or more layers. During the adhesive bonding it is advantageous when openings exist between the fiber cords. Thanks to the partial stiffening and a mutual fixing of the fiber cords, which are arranged transversely to one another, the danger of unfavorable deformations of the composite material in accordance with the invention is excluded.

The invention will be explained in the following with reference to the drawings. Shown are:

- Fig. 1 a detail of an impregnation bath,
- Fig. 2 a cross-section through a composite material in
 accordance with the invention,
- Fig. 3 an oblique view of a similar composite material and

Fig. 4 a plan view of a further embodiment of the composite material in accordance with the invention.

The impregnation method which is briefly explained in the introduction can be used in the manufacture of the composite material 1 in accordance with the invention. In this method, non impregnated fiber cords 2 and 3, which can be bundle-like or band-like, are woven together to form a textile surface in a first step. In this the fiber cords 2 to be stiffened are used for forming a warp of the web. These fiber cords 2 form a first array of fiber cords. A second array is given through fiber cords 3, by means of which the weft insertion is carried out. A pressure impregnation, which is partly illustrated with reference to Fig. 1, follows as the second step of the method. The web is drawn through a dispersion 4 of an impregnation bath in the warp direction, i.e. in the direction of the fiber cords 2, and in this is guided under a tension force around cylindrical deflection bolts 5. During this the impregnation takes place. The further steps such as drying and melting of the thermoplastic are carried out as in the known pressure impregnation.

At the deflection bolts 5, the cords 2, which are composed of fibers 20, are spread transversely to the transport direction and thermoplastic particles 40 from the dispersion 4 are embedded between the fibers 20. At every deflection about a bolt 5 an amount of thermoplastic is taken up which depends on the concentration of the bath and on the fiber diameter. The cords 3, which are woven in transversely to the fiber cords 2 and which are composed of fibers 30, also take up thermoplastic particles 40, however to a lesser extent, since the cords 3

are not spread. This is desirable since a semi-flexibility of the composite material 1 to be manufactured which is aspired to results in this manner: In this product the fibers 20 of the first array should be impregnated with substantially more plastic than the fibers 30 of the second array, so that the composite material 1 is stiff in the direction of the fibers 20 of the first array and is flexible transversely to this direction.

Fig. 2 shows a cross-section through the manufactured composite material 1, which is built up through two arrays of fiber cords 2 and 3 which are crossed at binding points 7 (see Fig. 3). Fibers 20 which are largely completely impregnated, i.e. embedded into a polymer matrix 21, form the fiber cords 2, which have a lens-shaped cross-section in the present exemplary embodiment. The transversely extending fiber cords 3 (or cord 3', lying further behind and being illustrated in broken lines) are impregnated with only a small proportion of thermoplastic, so that a good flexibility is retained. Fig. 3 illustrates the semi-flexibility of the composite material 1, with which narrow bending radii transverse to the fiber cords 2 are possible. Openings 6 between the fiber cords 2, 3, 3', which are advantageous for an adhesive bonding of the composite material 1 on a component to be reinforced, are also shown in Fig. 3.

It is advantageous when the fibers 20 of the first array have a substantially smaller diameter than the fibers 30 of the second array; since the greater the diameters of the fibers 30 are, the lesser is the impregnation of the cords 3 for the same method parameters (concentration and size of the thermoplastic particles 40; number of the

deflection bolts 5). For example carbon fibers can be chosen for the fine fibers 20 of the first array and glass fibers can be chosen for the coarse fibers 30 of the second array. The fiber cords 2 of the first array should have an impregnation which — in relation to the maximum capacity of plastic which can be taken up — amounts to at least 35%. The impregnation of the further fiber cords 3 should be less than 20%, preferably less than 5%.

The plastic for the impregnation is advantageously a thermoplastic or consists largely of such. It can also contain a small proportion of pulverized duroplastic and/or pulverized inorganic material.

A further manufacturing method consists in that stiff impregnated fiber cords are woven together with non impregnated fiber cords to form a textile surface in a first step, with the non impregnated fiber cords being used for forming a warp of the web. In a second step for carrying out a pressure impregnation, the web is again drawn through an impregnation bath in the warp direction and an only partial impregnation of less than 20%, preferably less than 5% — in relation to the maximum capacity of plastic which can be taken up — is carried out.

Fig. 4 is a plan view of a further embodiment of the composite material in accordance with the invention. Here the flexible fiber cords 3a and 3b form a second and a third array. In this embodiment, stiff impregnated fiber cords 2, which are arranged parallel to one another, have been welded together with flexible impregnated fiber cords 3a and 3b to form a grid. Here the cords 3a and 3b form two arrays of fiber cords. The

welding is carried out in accompaniment with a partial melting of the plastic impregnation and a pressing together of the fiber cords 2, 3a and 3b. The fiber cords 3a can for example also be secured on the rear side of the fiber cords 2 instead of on the same side as the fiber cords 3b.

Patent claims

1. Areally extended composite material (1) with fibers (20, 30) and plastic impregnations (21), which comprises at least two arrays of parallel fiber cords (2, 3) which extend in different directions and which form a web, mesh or grid, with it being possible for the fiber cords to be bundle-like or band-like,
characterized in that the fibers (20) of a first array (2) are impregnated with substantially more plastic (21) than the fibers (30) of a second and possibly of a further array (3) so that the composite material (1) is stiff in the direction of the fibers of the first array and is flexible transversely to this direction; and in that openings advantageously exist between the fiber cords.
2. Composite material in accordance with claim 1, characterized in that it is built up through two arrays of fiber cords (2, 3) which are crossed at binding points (7) and in this form a web or a mesh.
3. Composite material in accordance with claim 1 or claim 2, characterized in that the fiber cords (2) of the first array have an impregnation which — in relation to the maximum capacity of plastic which can be taken up — amounts to at least 35%, whereas the impregnation of the further fiber cords (3, 3'; 3a, 3b) is less than 20%, preferably less than 5%.
4. Composite material in accordance with any one of the claims 1 to 3, characterized in that the plastic for the impregnation is a

thermoplastic, to which a pulverized duroplastic and/or a pulverized inorganic material can be admixed.

5. Composite material in accordance with any one of the claims 1 to 3, characterized in that the fibers (20) of the first array have a substantially smaller diameter than the fibers (30) of the second or further array; and in that in particular the fine fibers (20) of the first array consist of carbon and the coarse fibers (30) of the second or further array consist of glass.
6. Method for the manufacture of a composite material in accordance with any one of the claims 1 to 5, characterized in that in a first step non impregnated fiber cords are woven together to form a textile surface, with the fiber cords (2) to be stiffened being used for forming a warp of the web and the further fiber cords (3) for a weft insertion; and in that in a second step a pressure impregnation is carried out in which the web is drawn through an impregnation bath (4) in the warp direction.
7. Method in accordance with claim 6, characterized in that substantially finer fibers (20) are used for the fiber cords (2) of the warp than for the fiber cords (3) of the weft insertion.
8. Method for the manufacture of a composite material in accordance with any one of the claims 1 to 5, characterized in that in a first step impregnated fiber cords (2) are woven together with non impregnated fiber cords (3) to form a textile surface, with the non impregnated fiber cords being used to form a warp of the

web; and in that in a second step a pressure impregnation is carried out with the web being drawn through an impregnation bath (4) in the warp direction and with an impregnation of less than 20%, preferably less than 5% — in relation to the maximum capacity of plastic which can be taken up — being carried out.

9. Method for the manufacture of a composite material in accordance with any one of the claims 1 to 5, characterized in that stiff impregnated fiber cords (2) which are arranged parallel to one another are welded together with flexible impregnated fiber cords (3a, 3b) to form a grid, with the welding being carried out in accompaniment with a partial melting of the plastic impregnation as well as with a pressing together.
10. Use of a composite material in accordance with any one of the claims 1 to 5, characterized in that components, in particular for the construction of machines or of buildings are reinforced at edges or at cylindrical partial surfaces with this composite material (1), with the composite material being adhesively bonded on or welded on in one or more layers.

Abstract of disclosure

The areally extended composite material (1) contains fibers (20, 30) which are impregnated with plastic (21). The composite material comprises at least two arrays of parallel fiber cords (2, 3) which extend in different directions and which form a web, mesh or grid. The fiber cords can be bundle-like or band-like. The fibers (20) of a first array (2) are impregnated with substantially more plastic (21) than the fibers (30) of a second and possibly of a further array (3). The composite material (1) is stiff in the direction of the fibers of the first array and is flexible transversely to this direction. Openings advantageously exist between the fiber cords.

(Fig. 3)

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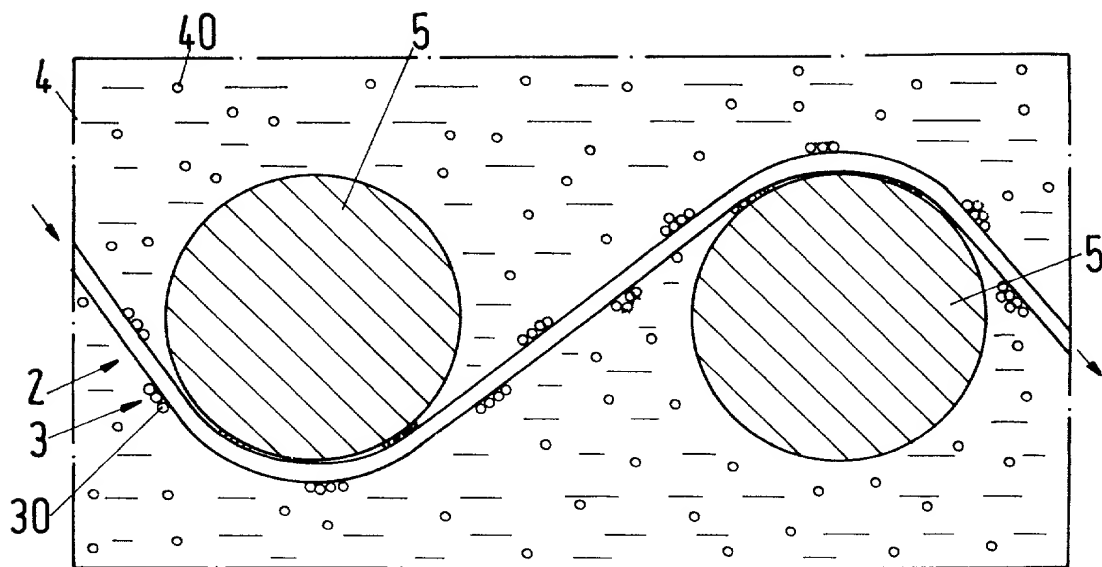


Fig.1

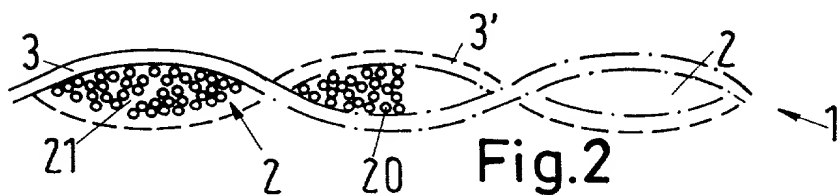


Fig.2

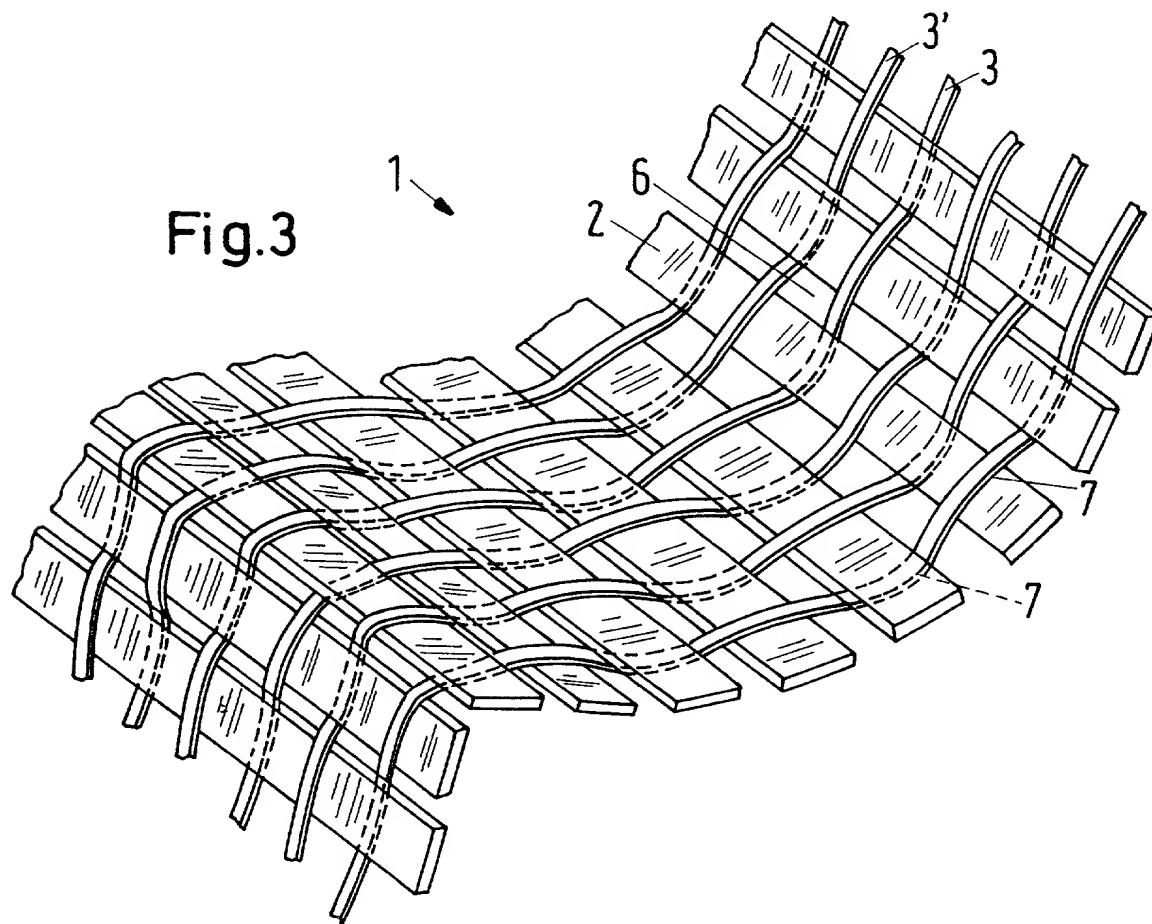
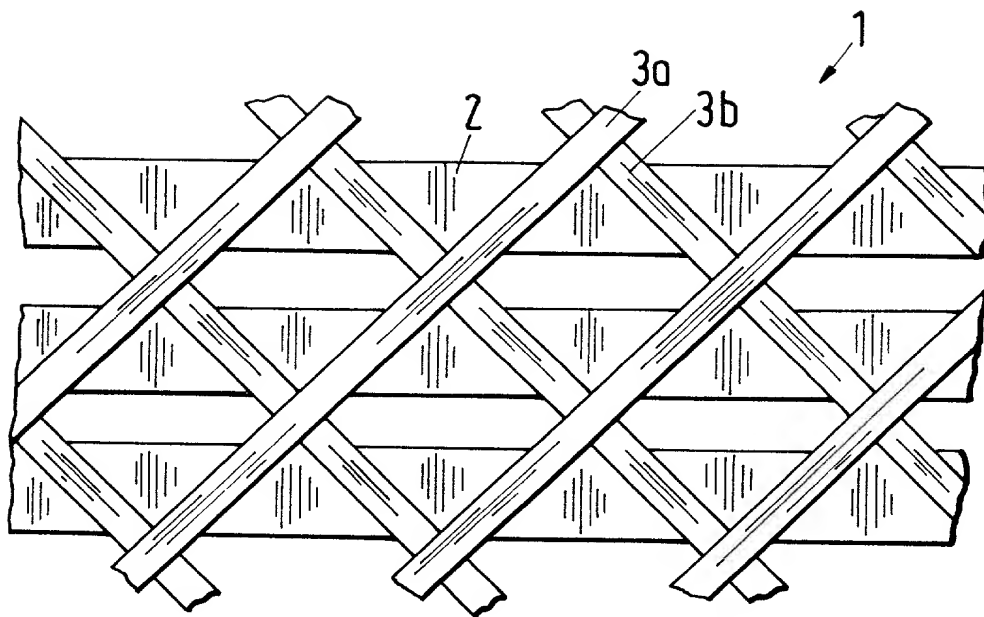


Fig.3

Fig.4



DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I declare that:

My residence, post office address and citizenship are as stated below next to my name; I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **Areally extended composite material with fibers and plastic impregnation**

the specification of which * is attached hereto or _____ was filed on _____ as Application No. _____ and was amended on _____ (if applicable).

I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56. I claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Country	Application No.	Date of Filing	Priority Claimed Under 35 USC 119
Europe	99 811 116.5	December 03, 1999	Yes <u>x</u> No ____
			Yes ____ No ____

I hereby claim the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below:

Application No.	Filing Date

I claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Application No.	Date of Filing	Status
		____ Patented ____ Pending ____ Abandoned
		____ Patented ____ Pending ____ Abandoned

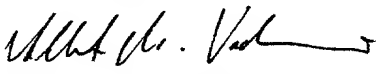
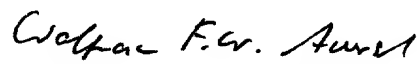
POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

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Residence & Citizenship	City	State/Foreign Country	Country of Citizenship	
Post Office Address	Post Office Address	City	State/Country	Zip Code

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signature of Inventor 1  Albert, M. Vodermayer	Signature of Inventor 2  Wolfram, F.W. Auersch	Signature of Inventor 3
Date 3.10.2000	Date 3.10.2000	Date